HEAT CONTROLLER, INC.

SERVICE MANUAL

MGD Series
Gas Furnaces

SEALED COMBUSTION GAS FURNACE
SERVICE MANUAL

INTRODUCTION

This manual is designed to help understand the basic fundamentals, operation, and troubleshooting of the MGD line of gas furnaces. It was designed to be used in conjunction with the installation manual and/or technical manuals provided with each gas furnace. This manual covers both natural gas and L.P. gas applications.

The controls on the furnace consist of electronic components which are not user serviceable. Therefore, it is essential that only competent, qualified, service personnel attempt to install, service, or maintain these products.

WARNING

The information contained in this manual is intended for use by qualified individuals who are familiar with the safety procedures required in installation and repair and who is equipped with the proper tools and safety equipment.

Installation or repairs made by unqualified persons can result in hazards subjecting the unqualified person making such repairs to risk of injury or electrical shock which can be serious, or even fatal not only to them, but also to persons being served by the equipment.

If you install or perform service on equipment, you must assume responsibility for any bodily injury or property damage, which may result, to you or others. We will not be responsible for any injury or property damage arising from improper installation, service, and /or service procedures.

Fundamentals of the Gas Furnace

All gas furnaces consist of four main components: a burner, a heat exchanger, a blower and a vent pipe or flue.

The burner is where the gas is delivered and burned. The gas furnace uses an electronic ignition system and hot surface igniter instead of a constantly burning pilot light to ignite the gas.

Whenever the thermostat calls for heat, the ignition device instantly lights the burners. The hot surface igniter is only energized when the thermostat first calls for heat and is de-energized after ignition. By not using any gas between ignition cycles, these components conserve the fuel previously used by a standing pilot light while providing added safety as well.

The heat exchanger transfers the heat produced from the burning gas to the home's conditioned air distribution system and is engineered to provide maximum heat transfer to the conditioned air.

The circulation blower moves the conditioned air through ducts to the location in the home where it is needed. This is a squirrel cage type blower powered by an electric motor, both of which have been sized for their specific application.

The flue exhausts the gaseous byproducts of combustion to the outdoors. Venting is also provided through the chimney. The MGD furnaces use sealed combustion systems tested and listed for use **only** with **RJ – Series Roof Jack Venting System**.

The MGD furnaces are set up to burn natural gas and can be converted to burn LP or propane.

ELECTRICAL SUPPLY

The unit cannot be expected to operate correctly unless it is properly connected (wired) to an adequately sized single branch circuit. Check the Technical Data Section of this manual to determine if the circuit is adequately sized.

WARNING

Electrical Shock hazard

Turn OFF electric power at fuse box or service panel before making any electrical connections and ensure a proper ground connection is made before connecting line voltage.

Failure to do so can result in property damage, personal injury and/or death.

SUPPLY VOLTAGE

Supply voltage to the unit should be a nominal 115 volts. **It MUST be between 104 volts and 127 volts**. Supply voltage to the unit should be checked WITH THE UNIT IN OPERATION. Voltage readings outside the specified range can be expected to cause operating problems. Their cause MUST be investigated and corrected.

ELECTRICAL GROUND

Grounding of the furnace IS REQUIRED for safety reasons.

SAFETY FEATURES

Flame sensing is attempted at all times. If a flame is sensed for 3 seconds and the thermostat W terminal is not energized, the draft inducer and main blower are re-energized. No further operation is allowed until flame detection is eliminated, at which point, the draft inducer performs a post-purge and the main blower will delay off. If a flame is sensed and the W terminal is energized, and the main valve is de-energized, the draft inducer and main blower are energized until the flame detection is eliminated at which time normal operation may resume.

The main valve is continuously monitored. If it is energized when it should not be, the draft inducer and main blower will be turned on. However, if during a normal ignition sequence, the air flow proving switch has been tested to be open, draft inducer energized, NPC closes and then the main valve is detected as being on, the ignition sequence stops and the draft inducer ed-energized. Since the NPC is wired serially with the main valve relay, de-energizing the draft inducer will open the NPC. If the main valve continues to be energized, then the draft inducer is re-energized. Main valve failure with W being de-energized will result in the main blower normal delay off being performed (once the problem has been corrected). Main valve failure during an ignition sequence will cause a recycle to occur.

During a normal ignition sequence (if the NPC has been tested and has functioned properly) an opening of the NPC will cause the main valve to be de-energized, the ignition cycle to be aborted, and the proper lockout code to flash. The main blower will complete its delay off (if energized) and the draft inducer will continue to operate until the NPC closes or the call for heat is removed.

If the high temperature limit or auxiliary limit opens without W energized, the draft inducer and main blower will be energized immediately. This condition will persist until the limit(s) reclose at which point an draft inducer post-purge and main blower normal delay off will be performed. If the high temperature limit or auxiliary limit opens with W energized the ignition cycle is aborted, the draft inducer and main blower will be energized immediately, and the failure counted toward a maximum of 5 limit cycles in a single call for heat. If the limit cycle is not the fifth cycle then the draft inducer and main blower will remain energized until the limit(s) re-close, at which point a normal ignition sequence will resume. However, if the limit cycle is the fifth cycle in a single call for heat the draft inducer and main blower will remain energized until the limit(s) re-close, at which point the draft inducer performs a post-purge and the main blower will perform a delay off and the control enters a one hour ignition lockout.

If the high temperature limit or auxiliary limit opens while the furnace is in heating mode and the thermostat is calling for heat (W), and the switch remains open for a continuous duration of 5 minutes the control enters a fan failure lockout mode. While in this mode the control does not allow the next ignition cycle to start until 20 minute4s after the limit recluses. Once the ignition cycle is started the control only allows the furnace to burn for a 30 second duration, at which point the main valve is shut off and the control starts another 20 minute ignition lockout and 30 second burn cycle. This pattern repeats indefinitely or until the thermostat call for heat is removed, or power to the control is removed. During this mode all other unsafe conditions (such as flame sense, main valve energized, limit open) are still monitored and are not superseded except 5 limit cycles does not result in a 1-hour lockout. However, any other failures do restart the lockout interval.

The proper polarity of the AC line is tested upon power up. If the AC “hot” line is connected to L2 then a “rapid flash code” will be indicated on the LED. Normal operation will still occur; however, it is highly improbable that flame sense will be detected. This condition will persist until power is cycled to the board.

RECYCLES

A recycle occurs when ignition has occurred and flame failure, flame circuit failure or a main valve failure during a call for heat is detected. If a recycle occurs before the heat fan delay ON has completed, the delay ON is bypassed and the heat fan comes ON immediately and performs the selected delay OFF. Up to five recycles may occur in a given operation. Following the fifth recycle the furnace enters a one-hour lockout.

SOFTWARE TIMING TABLE	
Pre-purge	30 sec.
Inter-purge	30 sec.
Igniter Warm-up Timer (1st. Pass)	30 sec.
Igniter Warm-up Timer (Retry)	30 sec.
Ignition Activation Period	5 sec.
Flame Establishing Period	2 sec.
Flame Stabilization Period	10 sec.
Flame Failure Timer (During Flame Stab.)	2 sec.
Flame Failure Response Time	0.75 sec.
Heat Fan Delay ON	selectable 60, 75, 90 sec.
Heat Fan Delay OFF	selectable 120, 150, 180 sec.
Cool Fan Delay OFF	18 sec.
Post-Purge	15 sec.
S/W Watchdog Timer	1.5 sec.
Ignition Lockout Timer	1 hr.
NPC Failure Timer 1 (Stuck Closed)	30 sec.
NPC Failure Timer 2 (Stuck Open)	30 sec.
NOTE: All timings given are nominal values.	

RETRIES

A retry occurs when an attempt to achieve ignition fails and no flame is detected. The main valve is turned off and the ignition cycle re-started. If three tries occur in a given operation sequence, the furnace is shut down for one hour. During the one-hour period, safety conditions are still monitored. Detection of an unsafe condition (such as flame not sensed, main valve energized, limit open) the proper action as previously described will be followed.

CONTROL (LOW) VOLTAGE

In order to insure proper unit operation the transformer secondary output must be maintained at a nominal 24 Volts. The 24 VAC Class 2 Transformer is protected from damage due to accidental short circuits with a 3 AMP fuse.

GAS PIPING

Supply piping must be sized in accordance with recommendations found in National Fuel Gas Code ANSI Z223.1/NFPA-54. In addition materials used in manufactured homes must comply with requirements contained in HUD Title 24, Section 3280.705 as well as A119.1 and A119.2 for recreational vehicles.

See chart in this manual for minimum sizes for NAT and LP pipe and tubing **serving the furnace only**.

NOTE: The gas inlet on the gas control valve is ½" NPT. The gas line may be installed through the bottom casing or on left or right side of furnace.

An adequately sized gas supply to the unit is required for proper operation. Gas piping which is undersized will not provide sufficient capacity for proper operation.

WARNING

Take care when connecting the gas line to the furnace gas valve. Use suitable wrenches to support the gas valve when tightening fittings to prevent miss-alignment of the attached burner orifice. Do not damage the gas valve as improper heating, explosion, fire or asphyxiation may result.

Do not use matches, lighters, candles or other open flame to check for leaks. Use a soap or water solution or a leak detector.

Do not pressure test the fuel system at more than 14" W.C. pressure once furnace has been connected to the gas line. Overpressure may void the warranty and damage the valve, which could cause an explosion, fire or asphyxiation.

NATURAL GAS

Inlet pressure to the unit should be checked (at the gas valve) with ALL OTHER GAS FIRED APPLIANCES OPERATING. Inlet pressure to the unit under these conditions MUST be a minimum of 4.5 in. W.C. If the inlet pressure is less, it may be an indication of undersized piping or regulator problems.

L. P. GAS

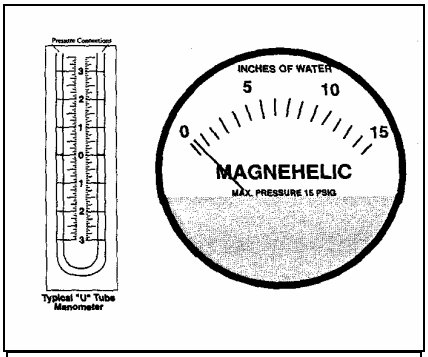
Inlet pressure to the unit should be checked in the same manner as for natural gas, however, with L.P. Gas, the inlet pressure MUST be a minimum of 11 in. W.C. If this cannot be obtained, problems are indicated in either the regulator or pipe sizing.

	Gas Pressures	
	Natural Gas	**LP Gas**
Minimum Inlet	4.5"W.C. (1120 Pa)	11"W.C. (2740 Pa)
Recommended Inlet	7" W.C. (1740 Pa)	11" W.C. (2740 Pa)
Maximum Inlet	13" W.C. (3230 Pa)	13" W.C. (3230 Pa)
Manifold Pressure	3.5" W.C. (870 Pa)	10" W.C. (2490 Pa)

CHECKING INPUT (FIRING) RATE

Once it has been determined that the gas supply (inlet) pressure is correct to the unit, it is necessary to check the input (firing) rate. This can be done in two ways. The preferred method is to check and adjust (as necessary) the manifold pressure. The second way is to "Clock" the gas meter (on Natural Gas Models).

CHECKING MANIFOLD PRESSURE



GAS PRESSURE TESTING DEVICES

1. Connect a U-tube manometer or Magnehelic gauge (0-12 in. W.C. range) to the pressure tap on the OUTLET side of the gas valve.

2. Turn gas ON and fire unit.

3. Manifold pressure should be set to 3.5 in. W.C. for Natural Gas, and to 10 in. W.C. for L.P. Gas.

4. This valve **is not** field adjustable.

5. For units above 2,000 Ft., insure that orifice size has been changed (per National Fuel Gas Code - Appendix "F") if gas supply has not already been de-rated for altitude by the gas supplier.

WARNING

Fire or explosion hazard.

Turn OFF gas at shut off before connecting U-tube Manometer or Magnehelic.

Failure to turn OFF gas at shut OFF before connecting Manometer or Magnehelic can result in personal injury and/or death.

"CLOCKING" GAS METER (NATURAL GAS)

1. Check with gas supplier to obtain ACTUAL BTU content of gas.

2. Turn OFF gas supply to ALL other gas appliances.

3. Time how many seconds it takes the smallest (normally 1 cfh) dial on the gas meter to make one complete revolution.

EXAMPLE			
Natural Gas BTU Content	**No. of Seconds Per Hour**	**Time Per Cubic Foot In Seconds**	**BTU's Per Hour**
1000	**3,600**	**48**	**75,000**
1,000 * 3,600 / 48 = 75,000 BTUH			

4. Calculate input rate by using ACTUAL BTU content of gas in formula shown in example.

CHECKING TEMPERATURE RISE

The unit is designed to operate within a certain specified range of temperature rise. See unit rating plate for allowable range.

Operating the unit outside the specified range may result in lower efficiency and/or comfort levels, as well as premature combustion component failures.

The temperature rise through the unit is the difference in temperature between the return air, and the supply air.

NOTE: BEFORE CHECKING TEMPERATURE RISE BE CERTAIN THAT MANIFOLD PRESSURE IS PROPERLY ADJUSTED

Temperature Rise can be checked by placing a thermometer in the return air duct as close to the unit as possible. Place a second thermometer in the supply duct at least two (2) feet away from the unit. This will prevent any false readings caused by radiation from the unit heat exchanger. Make sure that the FILTER IS CLEAN and that ALL REGISTERS AND/OR DAMPERS ARE OPEN.

Operate the unit for 15 minutes before taking temperature readings. Subtract the return air temperature from the supply air temperature. The result is the temperature rise. Compare with the allowable rise listed for the model (size) you are checking.

If the rise is not within the specified range, it will be necessary to change the heating blower speed. If the **rise is too high, it will be necessary to increase the blower speed. If the rise is too low, it will be necessary to reduce the blower speed.**

HIGH ALTITUDE OPERATION

This series of unit is designed to operate in the majority of the country without any modifications. Beginning at altitudes of 2,000 Ft. above sea level, certain measures need to be taken to insure continued, safe, reliable operation. For example, units must be de-rated for altitude (by changing orifice size) based upon the Btu content of the gas being supplied and installed altitude.

When servicing a unit installed at altitudes above 2,000 Ft., insure that it has been properly modified to operate at that particular altitude. Check with the gas supplier to determine if the gas being supplied has already been de-rated for altitude. If not, check the unit Installation and Operatins Manual for a listing of orifice sizes to be used with “standard” 1000 Btu per cubic foot Natural gas at higher altitudes.

ROOM THERMOSTATS

Room thermostats are available from several different manufacturers in a wide variety of styles. They range from the very simple and inexpensive Bi—metallic type to the complex and costly electronic set—back type. In all cases, no matter how simple or complex, they are simply a switch (or series of switches) designed to turn equipment (or components) ON or OFF at the desired conditions.

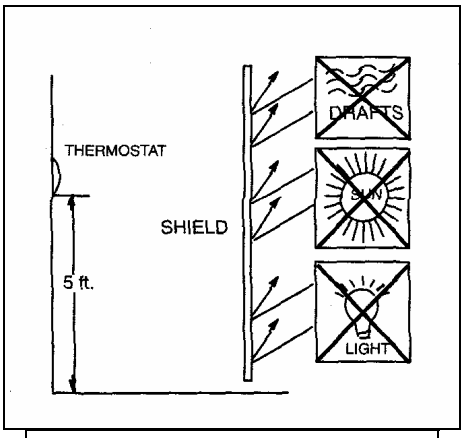
An improperly operating, or poorly located room *thermostat can be the source of perceived equipment* problems. A careful check of the thermostat and wiring must be made then to insure that it is not the source of problems.

LOCATION

The thermostat should not be mounted where it may be affected by drafts, discharge air from registers (hot or cold), or heat radiated from the sun or appliances.

The thermostat should be located about 5 Ft. above the floor in an area of average temperature, with good air circulation. Normally, an area in close proximity to the return air grille is the best choice.

Mercury bulb type thermostats MUST be level to control temperature accurately to the desired set—point. Electronic digital type thermostats SHOULD be level for aesthetics.



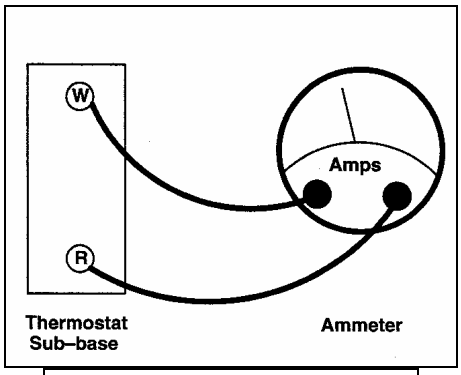
THERMOSTAT LOCATION

HEAT ANTICIPATORS

Heat anticipators are small resistance heaters built into most electro—mechanical thermostats. Their purpose is to prevent wide swings in room temperature during furnace operation.

In order to accomplish this, the heat output from the anticipator must be the same regardless of the thermostat used. Consequently, most thermostats have an adjustment to compensate for varying current draw in the thermostat circuit.

The proper setting of heat anticipators then is important to insure proper temperature control and customer satisfaction.



Measuring Current Draw

The best method to obtain the required setting for the heat anticipator is to measure the actual current draw in the control circuit ("W") using a low range (0—2.0 Amps) Ammeter. (See Illustration) After measuring the current draw, simply set the heat anticipator to match that value. If a low range ammeter is not available, a "Clamp—on" type ammeter may be used as follows:

1. Wrap EXACTLY ten (10) turns of wire around the jaws of a clamp--on type ammeter.

2. Connect one end of the wire to the 'W' terminal of the thermostat sub—base, and the other to the "R" terminal.

3. Turn power on, and wait approximately 1 minute, then read meter.

4. Divide meter reading by 10 to obtain correct anticipator setting.

Electronic thermostats do not use a resistance type anticipator. These thermostats use a Microprocessor that determines a cycle rate based on a program loaded into it at the factory.

Cycle rates are normally field adjustable for different types of equipment. The method of adjustment, varies from one thermostat manufacturer to another. Check with the thermostat manufacturer to find out the proper way of adjusting the cycle rate.

CONTROL WIRING

Control wiring is an important part of the total equipment installation, since it provides the vital communications link between the thermostat, and the equipment. It is often overlooked as the source of equipment malfunctions. Control wiring that is either too long, undersized, or improperly connected (be it simply loose, or on the wrong terminal) can in fact be the source of many equipment problems.

ALWAYS check to make sure that the control wiring is connected to the proper terminal(s) of the equipment and thermostat you are using. Remember *different thermostat manufacturers do not always identify thermostat terminals alike*. Connections MUST be clean and tight to insure trouble—free operation.

On the MGD models, the COOLING fan speed is energized via the Y terminal. The HEATING speed will be energized via the W terminal.

DIAGNOSTIC FEATURES

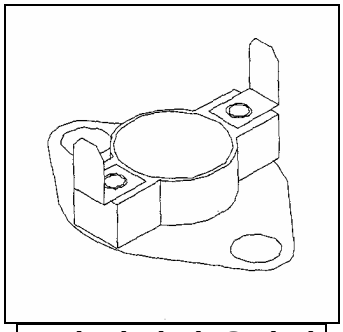
This section describes the diagnostic features incorporated into the control. The furnace electronic controls utilize an on-board LED to transmit a diagnostic flash code, which may be used in troubleshooting system problems. The table below describes these codes.

Table of Diagnostic Codes

FLASHES	FAULT CONDITION	CHECK
STEADY ON	NORMAL OPERATION	
1	IGNITION FAILURE (ONE HOUR LOCKOUT)	GAS FLOW, GAS PRESSURE, GAS VALVE, FLAME SENSOR
2	CLOSED PRESSURE SWITCH	PRESSURE SWITCH STUCK CLOSED
3	PRESSURE SWITCH FAILED TO CLOSE	VENTER, PRESSURE SWITCH, VENT BLOCKAGE
4	LIMIT SWITCH OPEN	MAIN LIMIT, AUX. LIMIT
5	GAS VALVE ENERGIZED WITH (W) OFF	GAS VALVE
RAPID FLASH	INCORRECT LINE VOLTAGE PHASING	L1 AND L2 CONNECTIONS REVERSED

LIMIT SWITCHES

Two different kinds of limit switches are used on the MGD series of gas furnaces. They are the main limit (manual re-set) and the auxiliary limit (automatic re-set) and are used on ALL models.



Typical Limit Switch

It must be remembered, that a limit switch is a safety device and other than for testing purposes, limit **switches should never be *jumped out*** *Limit switches* are normally closed electrical switches that are designed to open when their pre-determined limit setting has been reached. It should also be remembered, that when a limit switch opens, it more than likely is not due to a bad switch!

The cause of the opening limit must be found and corrected, before the furnace can resume proper operation.

WARNING

Fire hazard.

Limit controls are factory preset and MUST NOT be adjusted. Use ONLY manufacturer's authorized replacement parts.

Failure to do so can result in personal injury and/or death.

MAIN LIMIT SWITCH - 180°F MANUAL RESET

A Normally Closed switch located on the blower deck of the unit. Its purpose is to monitor supply air temperature, and to interrupt burner operation when a supply air temperature is sensed which would result in the furnace exceeding maximum allowable outlet air temperature. While the main limit is open, the combustion blower, and/or the circulating blower will be energized continuously. This control is a manual re-set control, which must be re-set manually when the temperature sensed drops to a safe level.

If this limit switch trips during furnace operation, it is more than likely due to a high temperature rise through the furnace. See checking temperature rise section in this manual.

High temperature rise can be caused by either OVER-FIRING (high manifold pressure, incorrect orifices, etc.) or LOW AIR FLOW (dirty filter, blower speed too low, excessive static in duct system, etc.)

To verify this, the cut-out temperature of the switch should be checked using a thermocouple type thermometer connected to the switch as follows:

1. Operate furnace for several minutes.

2. Block return air grille(s) to furnace.

3. *Observe temperature at which switch opens and burner* operation ceases.

4. Remove blockage from return grille(s).

5. Observe temperature at which switch closes and burner operation resumes.

6. Compare readings with the limit setting listed in the Tech. Service Data section for the model you are servicing.

If switch is opening within the specified range, then it is simply doing its job, and the cause of the over—temperature must be determined and corrected.

If, however, the switch is found to be opening prematurely, then it should be replaced. When replacing ANY limit switch, use ONLY a switch of EXACTLY the same temperature setting. Use of a different temperature limit switch can create a dangerous situation. Be certain you have the correct control part when replacing the limit switch.

AUXILLIARY LIMIT SWITCH - 140°F AUTO RESET

This limit switch is located inside the control box and automatically re-sets itself after the temperature of the switch has dropped below the factory set point. This switch is normally closed and operates much like the main limit switch. This switch can be tested using the same procedure as described in the main limit switch section of this manual.

When replacing, use only exact replacement parts with the same temperature setting. Use of a different temperature limit switch can create a dangerous situation.

PRESSURE SWITCHES

An air-proving pressure switch is used on all models to insure that a draft has been established through the heat exchanger before allowing burner operation.

All Models use a dual port switch which senses the pressure differential that is created by the combustion blower.

All Models use the same setting Normally Open pressure switch. The particular setting is required to insure continued SAFE, RELIABLE, operation. NEVER SUBSTITUTE a pressure switch with one that is similar in appearance. ONLY FACTORY PROVIDED or AUTHORIZED SUBSTITUTES ARE ACCEPTABLE.

If you are servicing a unit whose pressure switch will not close, or remain closed during operation, the operating pressure of that unit should be checked and compared to the switch setting.

Under normal operating conditions, sufficient negative pressure will be created to close the pressure switch, and keep it closed to keep the furnace section operating. Under abnormal conditions, however, such as a restricted vent (flue exhaust hood), or a leak in the heat exchanger, sufficient negative pressure will not be created. This will result in the switch failing to closed or failing to remain closed during furnace section operation.

COMBUSTION AIR BLOWER

All models use the same combustion air mounted on the inlet side of the heat exchanger. The purpose of the combustion blower is to establish a draft (flow) through the heat exchanger, to insure that all flue products are carried outside the unit via the flue exhaust hood.

There is a pressure tap on the induced draft blower housing, and one on the burner box, which connect via a silicone rubber tube to the taps on the unit's pressure switch. During normal operation the exhaust blower develops a sufficient differential pressure to close the pressure switch and keep it closed.

A 115-volt motor drives the exhaust blower. Basically there are only two problems that can be experienced with this component. It can have a motor failure, or it can become noisy due to bad bearings, loose blades, etc.

When servicing the blower be certain to insure that gaskets and sealing material are replaced. Leaks can cause operational problems, such as the pressure switch not closing.

CAPACITORS

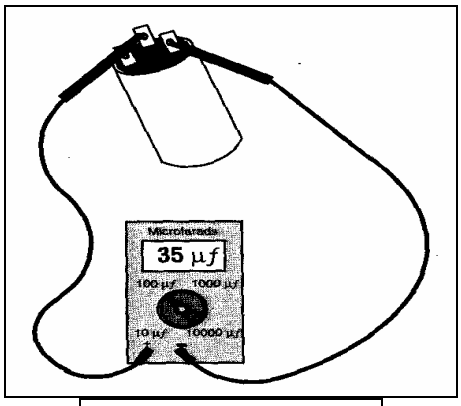
A permanent split capacitor is used for the circulating blower fan motor. Before replacing a motor, the condition of the capacitor should be verified, since it, and not the motor may be the source of the problem.

Before checking the capacitor, the supply power to the unit should be turned OFF.

The capacitor should then be discharged through a resistor before testing. A 20,000 Ohm 2 Watt resistor can be used for this purpose.

The condition of the capacitor should be verified with a capacitor analyzer, one that indicates the capacitor's value in microfarads, rather than with an Ohmmeter. The reason for this is that an Ohmmeter test can only indicate if a capacitor is OPEN, or SHORTED. It cannot verify if its value (microfarads) is within an acceptable range.

Capacitor should test to within 10% of its rated value. Capacitors testing outside this range should be replaced. A weak capacitor can be the cause of a motor failing to start, or failing to run at proper speed.



Checking Capacitor

BLOWER ASSEMBLY

All models use a multi-speed, permanent split capacitor motor, direct-drive, blower assembly. Different size (HP) motors and/or different diameter blower wheels are used in each model to obtain the required airflow. The method for accessing and removing the blower motor/assembly for servicing is described below.

Blower Assembly removal and replacement

1. Disconnect electrical power to the furnace.
2. Remove the blower access panel.
3. Unplug blower-wiring harness from plug in top of control box.
4. Remove the four screws securing the blower housing.
5. Slide entire housing to the left to disengage the tabs holding the right side.
6. Pull back on top of blower and lift bottom to disengage the two tabs on the bottom side.
7. Lift blower assembly out of furnace cabinet.
8. Installation is the reverse of these removal steps.

Blower wheel inspection

Visually inspect the blower wheel for accumulations of dirt or lint which will reduce airflow. Clean the blower wheel of any accumulations.

BLOWER SPEEDS

The wide variety of applications and installations of furnaces throughout the country makes it impossible to factory select blower speeds that will provide proper operation for all installations. The blower speeds for both heating and cooling must be field selected for each particular installation to insure proper operation.

The criteria for selecting the proper blower speeds ***IS NOT*** High for cooling, Low for heating. That may be how it works out SOMETIMES but it can be exactly the opposite.

The PROPER CRITERIA FOR SELECTING BLOWER SPEEDS is as follows:

A blower speed must be selected that will provide proper temperature rise through the furnace. See Checking Temperature Rise found elsewhere in this manual. The required CFM for a particular temperature rise can also be calculated by using the following formula:

$$\text{Temp. Rise} \times 1.08 = \frac{\text{Output BTU}}{\text{CFM}}$$

EXAMPLE: A model MGD75-E3A has an output of 60,000 Btuh. A temperature rise of 60°F (range of 45-75°F allowable) is desired. Measured external static pressure is 0.3" W.C. with a dry coil.

$$\frac{60{,}000}{60 \times 1.08} \quad \text{or} \quad \frac{60{,}000}{64.8} = 926 \text{ CFM}$$

Checking the blower performance data for this model, (see chart below) indicates that at 0.3" W.C., low speed will deliver 910 CFM to a system that has no coil installed. Accordingly, low speed should be used in this example for the HEATING speed. If a coil is installed however, the chart indicates that 865 CFM will be delivered on low speed and 1030 on MED speed.

BLOWER PREFORMANCE DATA - MGD FURNACE

ESP, IN. W.C. DUCT		0.1	0.2	0.3	0.4	0.5
A3/12 BLOWER - 10 X 8, 1/3 HP, 3 SP (Accessory P/N: 87-1008-3/12A1						
CFM - NO COIL	LOW	980	950	910	875	825
"	MED	1220	1170	1120	1065	1015
"	HIGH	1460	1400	1340	1270	1195
CFM - WITH COIL	LOW	945	905	865	815	775
"	MED	1130	1085	1030	970	905
"	HIGH	1300	1240	1180	1105	1035
BLOWER - 10 X 8, 3/4 HP, 4 SP (Accessory P/N: 87-1008-4/16A1						
CFM - NO COIL	LOW	995	960	915	875	825
"	MED	1205	1165	1130	1090	1045
"	MED HIGH	1470	1425	1385	1345	1310
"	HIGH	1810	1765	1720	1680	1635
CFM - WITH COIL	LOW	950	905	865	835	790
"	MED	1145	1115	1080	1035	1000
"	MED HIGH	1375	1345	1315	1280	1245
"	HIGH	1700	1660	1620	1575	1540

SELECTING BLOWER SPEEDS

After determining necessary CFM and speed tap data, refer to the unit wiring diagram for the correct speed tap.

BURNERS

Burners used in this series are of the INSHOT type. Their operation can be compared to that of a torch since they produce a hard, sharp, flame. Proper adjustment of the manifold gas pressure is essential, to insure that the burners are operating properly.

The burners used in this series ARE NOT EQUIPPED WITH AIR SHUTTERS, as none are required. Proper operation is obtained by insuring that the orifice size and manifold pressure are correct for the fuel being used and the altitude of the installation.

PILOT ADJUSTMENT (All Models)

Pilot flame adjustment is the same for all models, regardless of which ignition system is used. The pilot flame should be adjusted to envelop flame sensor. Turn pilot adjustment screw COUNTERCLOCKWISE (out) to INCREASE and CLOCKWISE (in) to DECREASE.

BURNER/HEAT EXCHANGER INSPECTION & CLEANING

Check the exterior and the interior flue gas passages of the heat exchanger for any evidence of deterioration due to corrosion, cracking or other causes. If signs of scaling or sooting exist, remove the burners and clean the heat exchanger as required.

Note: Under normal operating circumstances, the heat exchanger should NOT require cleaning. If a unit requires cleaning, it indicates that there are likely operational problems such as low gas pressure, etc. which may cause sooting. The cause of such improper operation MUST be determined and corrected to insure continued safe, reliable operation.

INSPECTION AND CLEANING OF BURNER ASSEMBLY AND HEAT EXCHANGER

Inspecting the burners and heat exchanger tubes requires the use of a light and small mirror on an extension handle.

I. Disconnect all electrical power to unit.

2. Turn gas OFF at manual shut off valve.

3. Disconnect gas pipe at union.

4. Disconnect wires from gas valve, note connections.

5. Remove screws securing the burner box cover and remove the cover, gas valve, and burner assembly as one unit.

6. Clean burner assembly with a stiff brush.
   Note: The burner assembly is equipped with a hot surface igniter. Use extreme caution not to damage it. This igniter is usually made of a ceramic type material, which is VERY brittle, and breaks easily.

7. Clean interior of heat exchanger including flue gas passages by using small brushes and a vacuum cleaner. It may be necessary to fabricate handle extensions for the brushes to reach the areas that require cleaning. Re-inspect after cleaning and replace the heat exchanger if defective.

8. Reinstall parts and gaskets in reverse order. Any gaskets damaged during disassembly MUST be replaced with new gaskets.

9. Turn gas **ON** and check for leaks. Any leaks found MUST be repaired immediately.

10. Install all access panels, turn electrical power on and check furnace for normal operation.

HEAT EXCHANGER REMOVAL/REPLACEMENT

Removal of the heat exchanger from the unit is only required if the heat exchanger has failed. The causes of heat exchanger failures are normally NOT due to defects in material and workmanship in the heat exchanger itself.

Before replacing any heat exchanger, the cause of its failure must be determined and corrected. Failure to do so will cause the replacement heat exchanger to also fail for the same reasons. Some possible causes of heat exchanger failure are as follows:

1. Temperature rise too high, causing heat exchanger to exceed design-operating temperature. Operating outside allowable temperature rise range will eventually cause cracks to appear in the heat exchanger. Filter may be dirty, registers may be closed off, blower speed may be too low, or unit may be over—fired as a result of manifold pressure being too high or incorrect orifice being used.

2. Temperature rise too low, causing heat exchanger to never achieve design-operating temperature. Operating outside allowable temperature rise range can allow condensation to form inside the heat exchanger, eventually causing corrosion to appear in the heat exchanger. Blower speed may be too high, return air duct may be open and leak ambient air or unit may be under—fired as a result of manifold pressure being too low or incorrect orifice being used.

DIAGNOSTIC FEATURES

This section will describe the diagnostic features incorporated into the control. The furnace electronic controls utilize an on-board LED to transmit a diagnostic flash code, which may be used in troubleshooting system problems. The table below describes these codes.

Table of Diagnostic Codes

FLASHES	FAULT CONDITION	CHECK
STEADY ON	NORMAL OPERATION	
1	IGNITION FAILURE (ONE HOUR LOCKOUT)	GAS FLOW, GAS PRESSURE, GAS VALVE, FLAME SENSOR
2	CLOSED PRESSURE SWITCH	PRESSURE SWITCH STUCK CLOSED
3	PRESSURE SWITCH FAILED TO CLOSE	VENTER, PRESSURE SWITCH, VENT BLOCKAGE
4	LIMIT SWITCH OPEN	MAIN LIMIT, AUX. LIMIT
5	GAS VALVE ENERGIZED WITH (W) OFF	GAS VALVE
RAPID FLASH	INCORRECT LINE VOLTAGE PHASING	L1 AND L2 CONNECTIONS REVERSED

PRESSURE CONTROL LOCKOUT

Pressure control lockout happens when the differential pressure switch fails to operate properly during a call for heat. If the pressure switch is continuously closed, even with the draft inducer off, no further operation of the furnace will occur, except if flame is detected, main valve is detected, or if the limit opens. If the condition persists for 30 seconds, the control will flash lockout code 3 until the condition is corrected or the call for heat is removed. If the differential pressure switch will not close after the draft inducer has been energized for 30 seconds, the control will begin to flash lockout code 3 until the condition is corrected or the call for heat is removed. If the differential pressure switch has operated properly but opens during normal operation with W energized, the main valve is de-energized immediately and lockout code 3 will flash. If the differential pressure switch re-closes, normal operation will return but the differential pressure switch failure will be counted as a recycle. If the differential pressure switch does not re-close, the control will continue to flash the lockout code until it does close or the call for heat is removed.

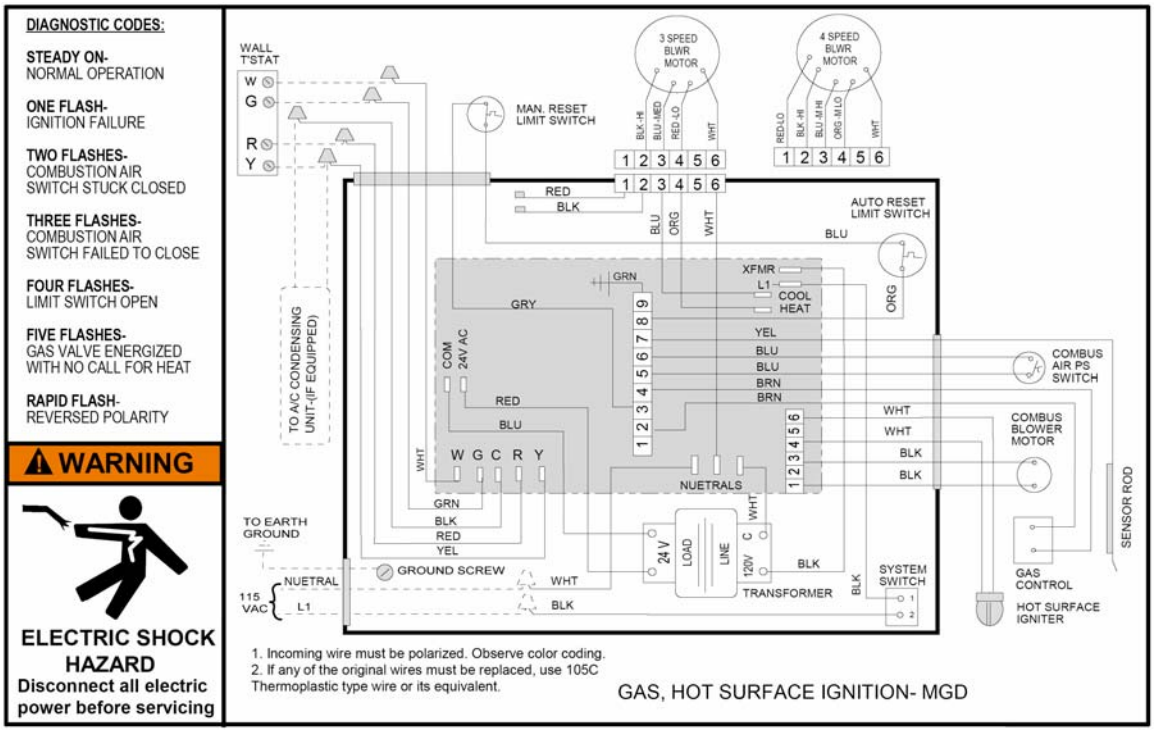
FLAME SENSOR INPUTS

The flame sensor input is capable of reliably detecting the presence of a flame through the use of the flame Rectification Principle. In order to achieve this, the circuit must properly sense a flame or its absence whenever the AC Line voltage (between L1 and L2) is at 90 Vrms, and flame rectification current built into the system is recognized. This allows the verification of the circuits operation if a flame is detected.

ONE HOUR LOCKOUT

A one-hour lockout occurs following: three retries, five recycles, and five limit cycles in a single call for heat. During the one-hour lockout, flame detection, limit conditions, and main valve are tested. Any improper results will cause the appropriate action to occur. While in the one-hour lockout, the cooling operation of the furnace will continue to function fully. Removing the call for heat will reset the one-hour lockout period.

WIRING DIAGRAM, MGD



Design, material, performance data and components subject to change without notice.

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